REMARKS

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have incorporated the subject matter of each of claims 2 and 3 into claim 1; and, correspondingly, have cancelled claims 2 and 3 without prejudice or disclaimer.

In addition, Applicants are adding new claims 18 and 19 to the application. Claim 18, dependent on claim 1, recites that the nanocolloidal metal particle concentration is 250 to 3000 mass ppm. Note, for example, Section [0020] bridging pages 17 and 18 of Applicants' specification.

New claim 19 defines a method for producing a concentrated metal nanocolloidal liquid having specified characteristics. The method includes adding to an aqueous metal salt solution a reducing agent solution, to react therewith; causing the resultant reaction mixture to pass through a column filled with an ion-exchange resin to prepare a dilute metal nanocolloidal liquid; and concentrating the dilute metal nanocolloidal liquid through thermal treatment under non-boiling conditions for evaporation of the dispersion medium contained in the nanocolloidal liquid. See, for example, pages 20-22 of Applicants' specification.

Applicants note with thanks the indicated allowability of the subject matter of claims 13-15. However, as will be shown in the following, it is respectfully submitted that all claims presently pending in the above-identified application, including claims 1, 7 and 12 (prior claims of claims 13-15), should be allowed, such that claims 13-15 should be allowed without having to be set forth in independent form.

Applicants respectfully submit that all of the claims presently pending in the above-identified application patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed September 4, 2008, that is, the teachings of the U.S. patents to Shipley, No. 3,011,920, and to Stiles, No. 3,230,034, under the provisions of 35 USC 102 and 35 USC 103.

Initially, it is noted that the Examiner has not rejected the subject matter of claim 2 over the teachings of Shipley. Note Item 3 on pages 2-4 of the Office Action mailed September 4, 2008. Moreover, it is noted that the subject matter of claim 2 has been incorporated into claim 1, claim 1 being the sole previously considered independent claim; and that newly added claim 19 also includes the subject matter of previously considered claim 2. For this reason alone, it is respectfully submitted that claim rejections over the teachings of Shipley have been overcome, on this basis alone.

In any event, it is respectfully submitted that, as acknowledged by the Examiner in the claim rejections, Shipley would have neither disclosed nor would have suggested such a metal nanocolloidal liquid, or such method for producing a concentrated metal nanocolloidal liquid, or such method for producing a metal-on-carrier using such liquid, as in the present claims, or the metal-on-carrier formed, including, inter alia, wherein the nanocolloidal metal particle concentration in the liquid is 250 mass ppm or more.

In connection with the rejection of claims over Stiles, it is noted that the Examiner has not rejected to claims 8-16 over the teachings of Stiles. In view of amendments to, e.g., claim 1, it is respectfully submitted that since the rejection over Shipley has been overcome, claims 8-12 and 16, in addition to claims 13-15, should contain allowable subject matter.

In any event, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such metal nanocolloidal liquid as in the present claims, containing substantially no protective colloid-forming agent, and wherein the liquid has a nanocolloidal metal particle concentration of 250 mass ppm or more and a protective colloid-forming agent content, as reduced to carbon, equivalent to a total carbon of 0-200 mass ppm with respect to the nanocolloidal particles. See claim 1. Note also claim 19.

Furthermore, it is respectfully submitted that the teachings of this applied references would have neither disclosed nor would have suggested such a metal nanocolloidal liquid as in the present claims, having features as discussed previously in connection with claim 1, and, additionally, wherein the nanocolloidal metal particles have a mean particle size of 1-20 nm (see claim 4); and/or wherein the nanocolloidal metal particles are nanocolloidal particles of at least one noble metal selected from the group consisting of platinum, ruthenium, palladium, rhodium, rhenium, osmium and gold (see claim 5); and/or wherein the dispersion medium, included in the nanocolloidal liquid with the nanocolloidal metal particles, is an aqueous medium (see claim 6); and/or wherein the nanocolloidal metal particle concentration is 250-3000 mass ppm (see claim 18).

In addition, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a method for producing a concentrated metal nanocolloidal liquid as in the present claims, the metal nanocolloidal liquid formed having, inter alia, nanocolloidal metal particles which have a nanocolloidal metal particle concentration of 250 mass ppm or more and containing

substantially no protective colloid-forming agent, such method including adding a reducing agent solution to an aqueous metal salt solution for reaction, with the resultant reaction mixture being caused to pass through a column filled with an ion-exchange resin to prepare a dilute metal nanocolloidal liquid; and concentrating such dilute liquid through thermal treatment under non-boiling conditions for evaporation of the dispersion medium contained in the liquid. See claim 19.

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a method for producing a metal-on-carrier, or such metal-on-carrier formed, as in the present claims, using the metal nanocolloidal liquid of claim 1 (see claim 7; note also claim 17); and/or further definition of the carrier as in claim 8, with the nanocolloidal metal particles being caused to be carried on the carrier through electrodedeposition; and/or wherein the metal nanocolloidal liquid contains a reducing agent, employed during production of the nanocolloidal liquid, in an amount as in claim 9; and/or wherein the electrically conductive carrier is further defined as in claim 10; and/or wherein the electrically conductive carrier has been subjected to surface treatment in advance by use of the reducing agent employed during production of the metal nanocolloidal liquid (see claim 11); and/or wherein the dispersion medium is an aqueous medium, with the nanocolloidal particles being caused to be carried on the carrier through spraying (see claim 12); and/or wherein the carrier is formed of a material as set forth in claim 16.

The present invention is directed to a metal nanocolloidal liquid, a method for producing such liquid, a method for producing a metal-on-carrier using such liquid, and the metal-on-carrier formed.

In recent years, metal-on-carriers formed of a metal carried on a carrier such as carbon material, ceramic/metal oxide material, metallic material, or organic polymer material, have become of interest as a functional material in a variety of fields. Various fields of use of such metal-on-carriers are described, for example, in the sole full paragraph on page 2 of Applicants' specification, with further description of uses thereof on pages 3-6 of Applicants' specification, for example.

In previously proposed metal nanocolloidal liquids, generally the nanocolloidal metal particles exhibit poor dispersion stability and are prone to form aggregates. Therefore, generally, a water-soluble polymer compound or a protective colloid-forming agent is added to the metal nanocolloidal liquid, and a protective colloid is formed, whereby the dispersion stability of the nanocolloidal metal particles is improved. Note the first full paragraph on page 8 of Applicants' specification.

However, when using such protective colloid-forming agent, when the nanocolloidal metal particles are caused to be carried on a carrier, the protective colloid-forming agent is deposited on the surfaces of the nanocolloidal metal particles carried on the carrier, and in some cases such organic-substance-containing metal-on-carriers may fail to sufficiently perform its intended function. In such a case, the metal-on-carrier must be subjected to treatment for removal of the organic substance (for example, a firing treatment). However, in some cases the carrier cannot be subjected to a firing treatment, so that employment of the protective colloid-forming agent poses a problem of limiting the type of carrier that can be employed.

While it has been proposed to use a metal nanocolloidal liquid containing no protective colloid-forming agent, such proposed method raises problems in that the

particles are caused to be carried on the carrier at a low concentration, and an insufficient amount of particles are carried on the carrier. Thus, it is desired to increase the amount of nanocolloidal metal particles caused to be carried on a carrier, without the use of a protective colloid-forming agent, and wherein such particles are caused to be carried on a carrier in a single operation.

An additional problem arises in attempts to increase amount of nanocolloidal metal particles caused to be carried on a carrier, especially where the particles are deposited from a liquid employing no protective colloid-forming agent, in that when the liquid containing nanocolloidal metal particles in a large amount is to be prepared, the colloidal particles are prone to aggregate and precipitate.

Thus, a demand has arisen for a metal nanocolloidal liquid containing nanocolloidal metal particles in a large amount, containing no protective colloid-forming agent, and exhibiting good dispersion stability. In this regard, and as described in the first paragraph on page 11 of Applicants' specification, in a conventional technique, when a metal nanocolloidal solution is to be prepared from platinum particles without employing a protective colloid-forming agent, the amount of the particles contained in the solution is limited to about 150 mass ppm.

Against this background, Applicants provide a metal nanocolloidal liquid containing substantially no protective colloid-forming agent and exhibiting excellent dispersion stability over a long period of time, even when colloidal metal particles are contained in the liquid in a relatively large amount. As a result of extensive studies, the present inventors have found that such objectives are achieved by preparing a dilute metal nanocolloidal liquid containing the metal particles and a dispersion medium, but

containing substantially no protective colloid-forming agent, and removing the dispersion medium from the nanocolloidal liquid through evaporation under mild (e.g., non-boiling) conditions for concentration. See, e.g., newly added claim 19. Moreover, the nanocolloidal liquid according to the present invention has a nanocolloidal metal particle concentration of at least 250 mass ppm, with relatively no protective colloid-forming agent. See, e.g., claim 1.

As to what is meant by the "protective colloid-forming agent", note Section [0018] bridging pages 16 and 17 of Applicants' specification. As to the advantages achieved by the present invention, note pages 47 and 48 of Applicants' specification.

Stiles discloses catalyst aggregates of crystallites of a catalytic material which are kept apart by crystallites of a refractory which melts above 1000°C, the aggregates thus constituted thereafter having crystallites of a refractory which melt above 1000°C added thereto to keep the former two groups of crystallites apart and thus to form a catalytic aggregate which is stabilized against crystallite growth and inactivation at high temperatures. Note column 1, lines 10-19. Note, in particular, Fig. 1 and the description in connection therewith in column 1, lines 30-46 of this reference. Fig. 1 shows an association of the crystallites, with the crystallites of the refractories keeping each other apart and also keeping, e.g., copper chromite crystallites apart so that crystal growth is hindered. See, also, column 2, lines 37-50 of Stiles, disclosing that the catalytic material can be formed in situ as by chemical decomposition; that copper chromite can be precipitated in desired form by adding ammonium hydroxide to an aqueous solution of chromic acid and copper nitrate, and that this gives a precipitate of basic copper chromate which on heating decomposes to copper chromite. This patent

also discloses that there can be made a colloidal dispersion of silica in water containing chloroplatinic acid and the chloroplatinic acid can be reduced to platinum with well-known reducing agents such as formaldehyde or methanol, giving metallic platinum colloidally dispersed upon particles of silica. This patent goes on to disclose that in this instance silica serves as an interspersant.

From the foregoing, as well as from a full review of Stiles, it is respectfully submitted that this reference would have neither disclosed nor would have suggested such a metal nanocolloidal liquid as in the present claims, having a nanocolloidal metal particle concentration of 250 mass ppm or more, or protective colloid-forming agent content, as in the present claims.

Attention is directed to the teachings of the applied reference to Shipley, in column 2, lines 27-34, describing that, for stability, it is preferred that the colloidal solution also contain a protective colloid, and/or a deflocculating agent. Acknowledging that Shipley has not been applied together with Stiles, it is respectfully submitted that the disclosure in Shipley shows the state of the art that, generally, a protective colloid-forming agent is provided in colloid liquids. To the contrary, according to the present invention the metal nanocolloidal liquid contains substantially no protective colloid-forming agent (that is, wherein the protective colloid-forming agent content as reduced to carbon is equivalent to a total carbon of 0-200 mass ppm with respect to the nanocolloidal metal particles), while still achieving dispersion stability and achieving other advantageous effects of the present invention.

Moreover, it is respectfully submitted that Shipley per se teaches away from the liquid (and resulting products) containing substantially no protective colloid-forming agent, or concentration of colloidal metal particles in the liquid.

Thus, it is respectfully submitted that the teachings of the applied reference do not disclose, nor would have suggested, such liquid or use thereof as in the present claims, including wherein the liquid contains substantially no protective colloid-forming agent (that is, a protective colloid-forming agent content reduced as set forth now in claim 1, previously as set forth in claim 3).

In Item 4 on pages 4 and 5 of the Office Action mailed September 4, 2008, the Examiner makes no mention concerning the liquid containing substantially no protective colloid-forming agent, acknowledging that the Examiner contends therein that the disclosure at column 2, lines 44-50, of Stiles, "is considered to read upon", inter alia, claim 3. However, it is respectfully submitted that the such disclosure in Stiles provides no limitation concerning protective colloid-forming agent. Particularly in light of the conventional art at the time of Stiles, as can be seen in Shipley, it is respectfully submitted that Stiles would not have disclosed, nor would have suggested, a liquid containing substantially no protective colloid-forming agent as defined in the present claims, and advantages due thereto.

Comments by the Examiner in the first full paragraph on page 5 of the Office Action mailed September 4, 2008, in connection with claim 2, are noted. It is respectfully submitted that such definition of amount of interspersant, based upon the total weight of solids in the final precipitate or mixture of the catalyst plus interspersant,

would have neither taught nor would have suggested the metal particle concentration as in the present claims, and advantages due thereto.

It is emphasized that according to the present invention a concentrated metal nanocolloidal liquid is provided. Such concentrated metal nanocolloidal liquid, having the concentration of nanocolloidal metal particles as in the present claims, is provided by, e.g., thermal treatment of a dilute metal nanocolloidal liquid, under non-boiling conditions for evaporation, as in claim 19. It is respectfully submitted that the teachings the applied references do not disclose, nor would have suggested, such concentrated metal nanocolloidal liquid with a concentration of nanocolloidal metal particles as in the present claims, or formed using the thermal treatment of the dilute metal nanocolloidal liquid as recited in various of the present claims.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the above-identified application are respectfully requested.

Applicants request any shortage of fees due in connection with the filing of this paper be charged to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP,

Deposit Account No. 01-2135 (case 396.46268X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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